US007440433B2

(12) **United States Patent**
Rink et al.

(10) **Patent No.: US 7,440,433 B2**
(45) **Date of Patent: Oct. 21, 2008**

(54) **MOBILE IP NOTIFICATION**

(75) Inventors: **Fred Rink**, Fairview, TX (US); **Steven Currin**, McKinney, TX (US); **Jerry Mizell**, Plano, TX (US)

(73) Assignee: **Nortel Networks Limited**, St. Laurent, Quebec (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1224 days.

(21) Appl. No.: **10/741,953**

(22) Filed: **Dec. 19, 2003**

(65) **Prior Publication Data**

US 2005/0147069 A1 Jul. 7, 2005

(51) **Int. Cl.**
H04Q 7/24 (2006.01)

(52) **U.S. Cl.** **370/338**; 455/552.1; 455/557

(58) **Field of Classification Search** 370/338, 370/352, 355, 395.52; 455/414.1, 426.2, 455/552.1, 557

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,144,671 A * 11/2000 Perinpanathan et al. 370/409

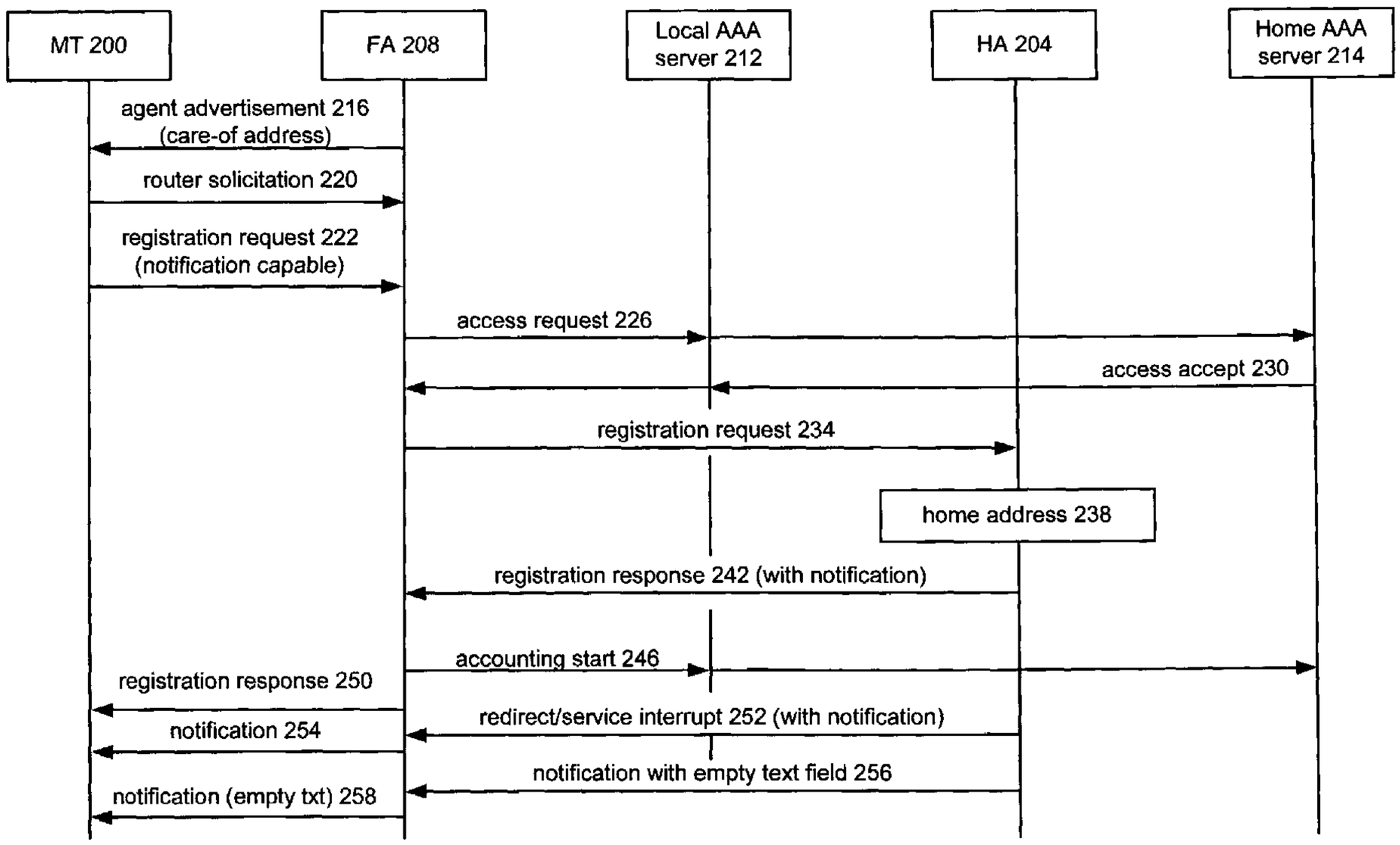
* cited by examiner

Primary Examiner—Temica M Beamer
(74) *Attorney, Agent, or Firm*—Garlick Harrison & Markison; James A. Harrison

(57) **ABSTRACT**

A home agent and a mobile terminal communicate to facilitate the home agent becoming aware of whether the mobile terminal is notification capable meaning the mobile terminal is able to receive notifications of specified events without an open browser window. If the mobile terminal is notification capable, the home agent provides notifications based upon specified events and conditions. The mobile terminal then provides an indication of the notification to the user even though a browser window is not open for displaying user messages. More specifically, the mobile IP registration process according to a mobile IP protocol is modified to add parameter extensions that allow the mobile terminal to provide this indication that it is notification capable. The home agent is notification capable as well and provides specified notifications to the mobile terminal upon the occurrence of a specified event either in a registration reply or during a data session or call.

20 Claims, 5 Drawing Sheets



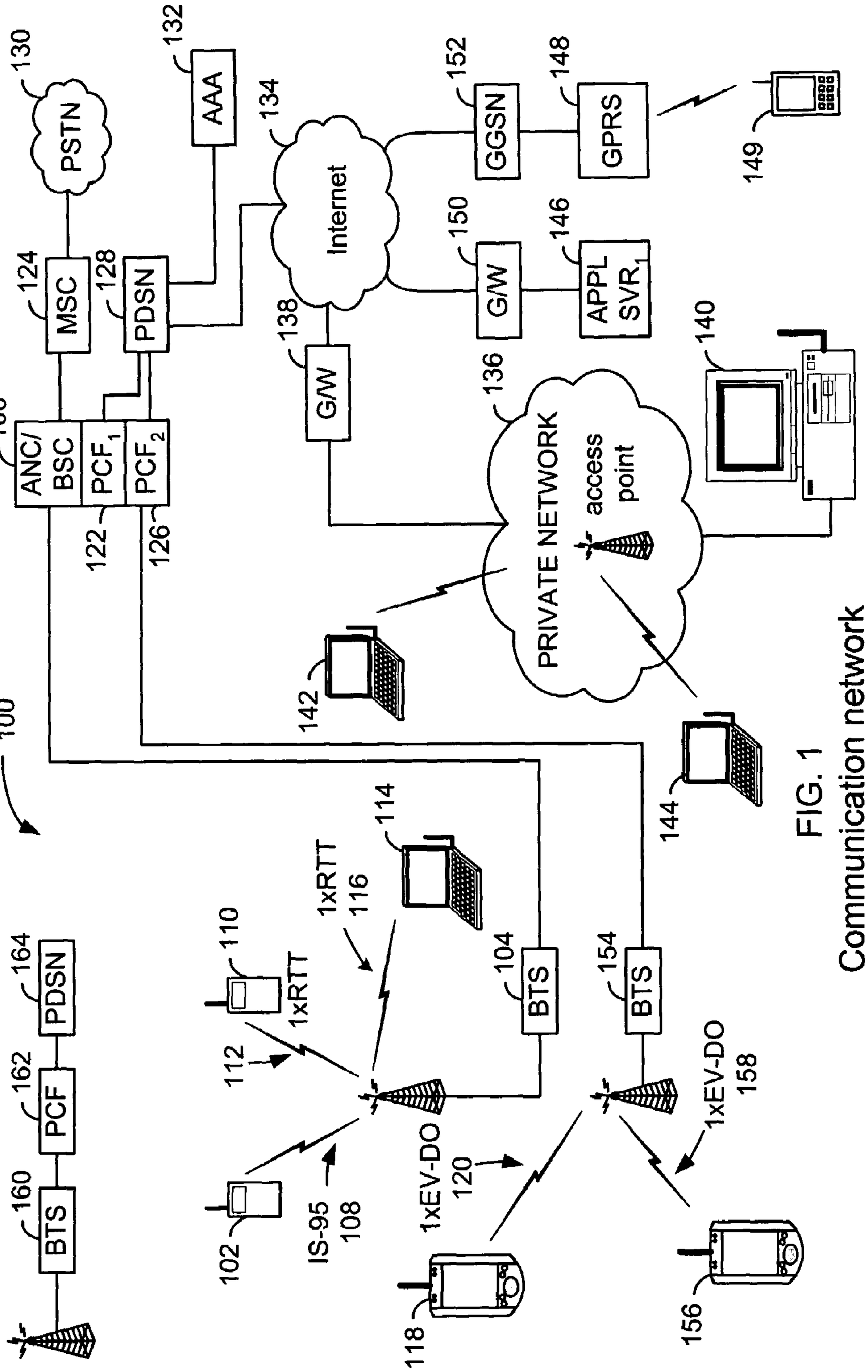


FIG. 1
Communication network

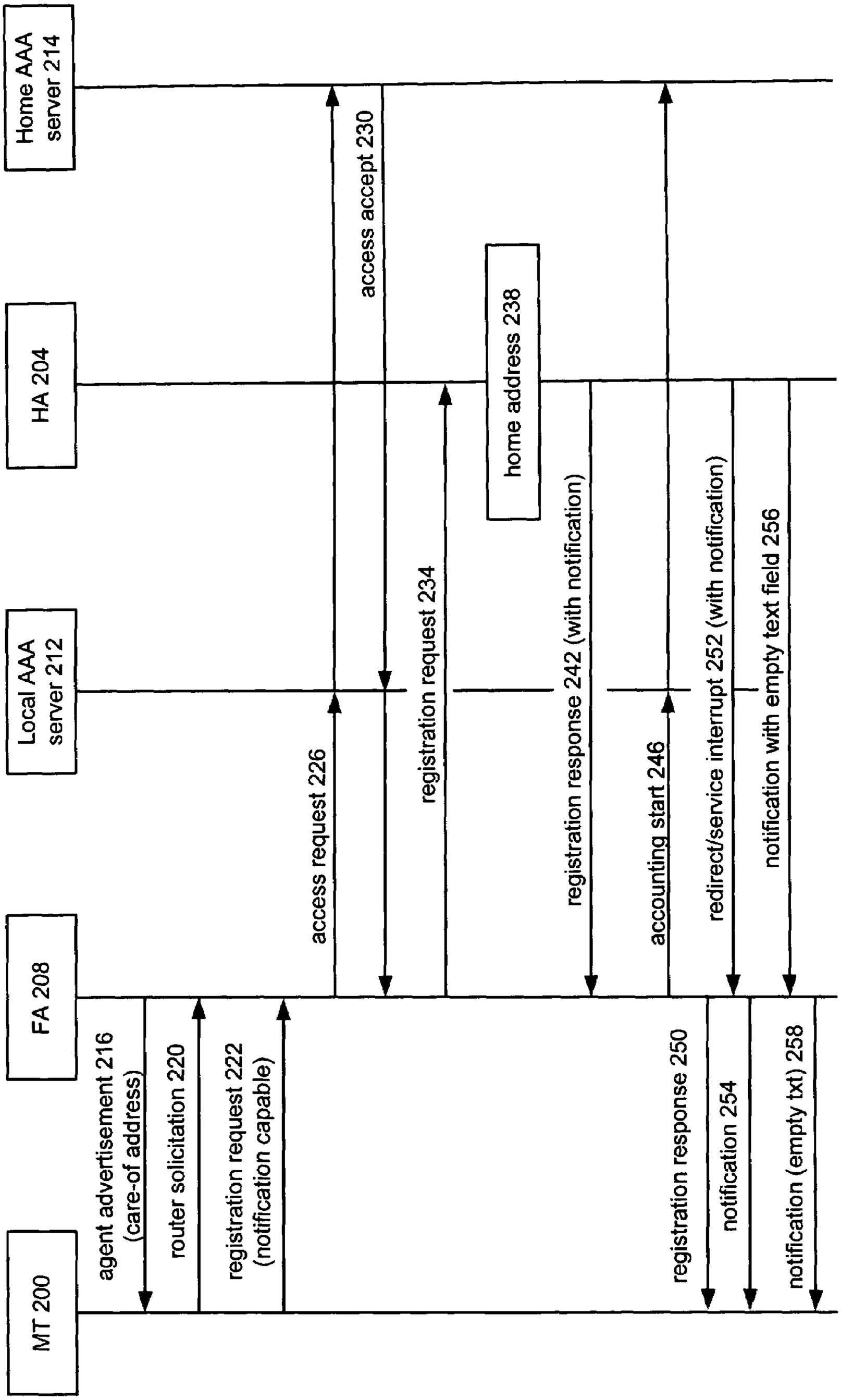

Home AAA server 214
HA 204
Local AAA server 212
FA 208
MT 200
access accept 230
home address 238
access request 226
registration request 234
registration response 242 (with notification)
accounting start 246
redirect/service interrupt 252 (with notification)
notification with empty text field 256
agent advertisement 216 (care-of address)
router solicitation 220
registration request 222 (notification capable)
registration response 250
notification 254
notification (empty txt) 258

FIG. 2

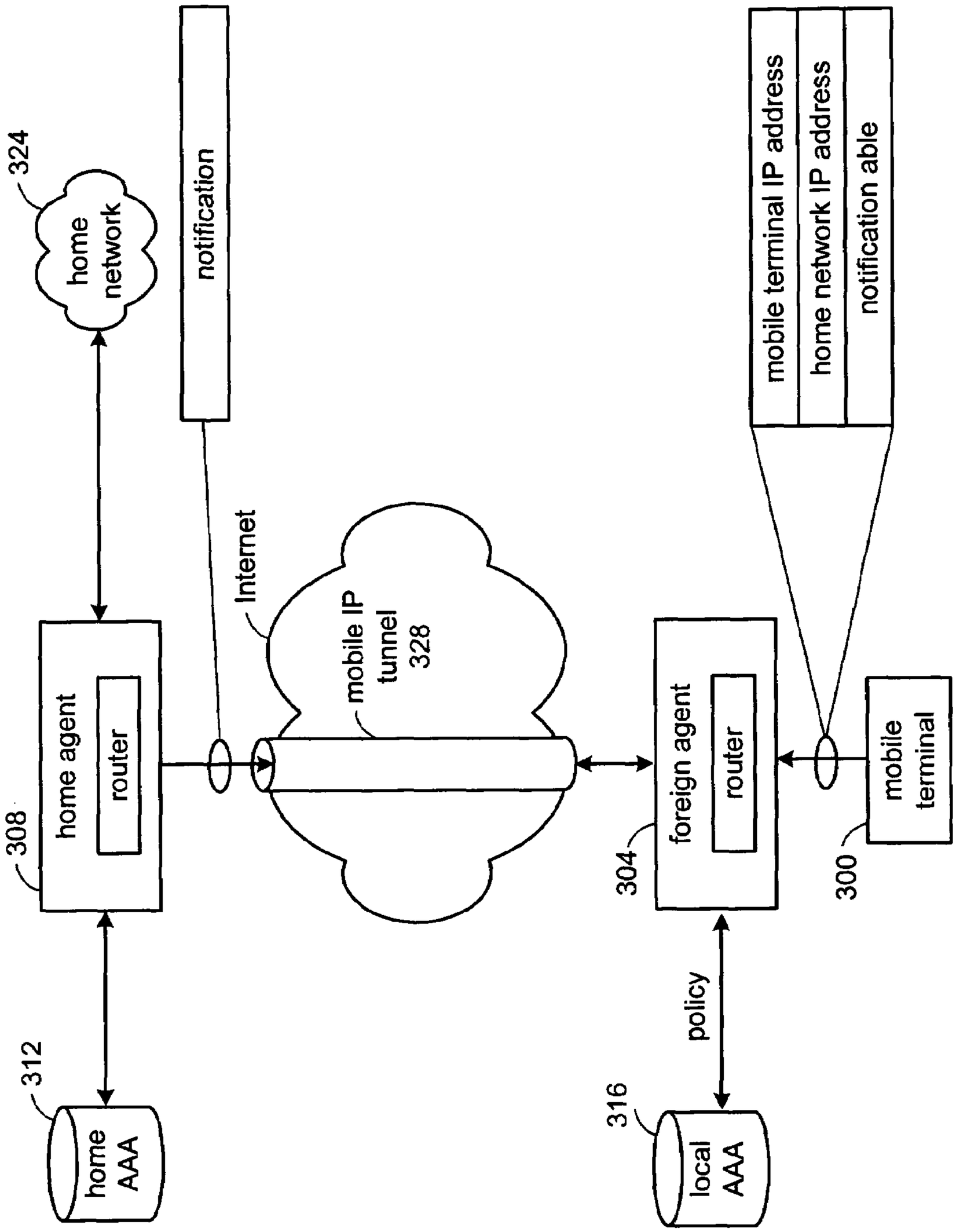

324
home network
notification
mobile terminal IP address
home network IP address
notification able
Internet
mobile IP tunnel 328
308
home agent
router
304
foreign agent
router
300
mobile terminal
312
home AAA
policy
316
local AAA

FIG. 3

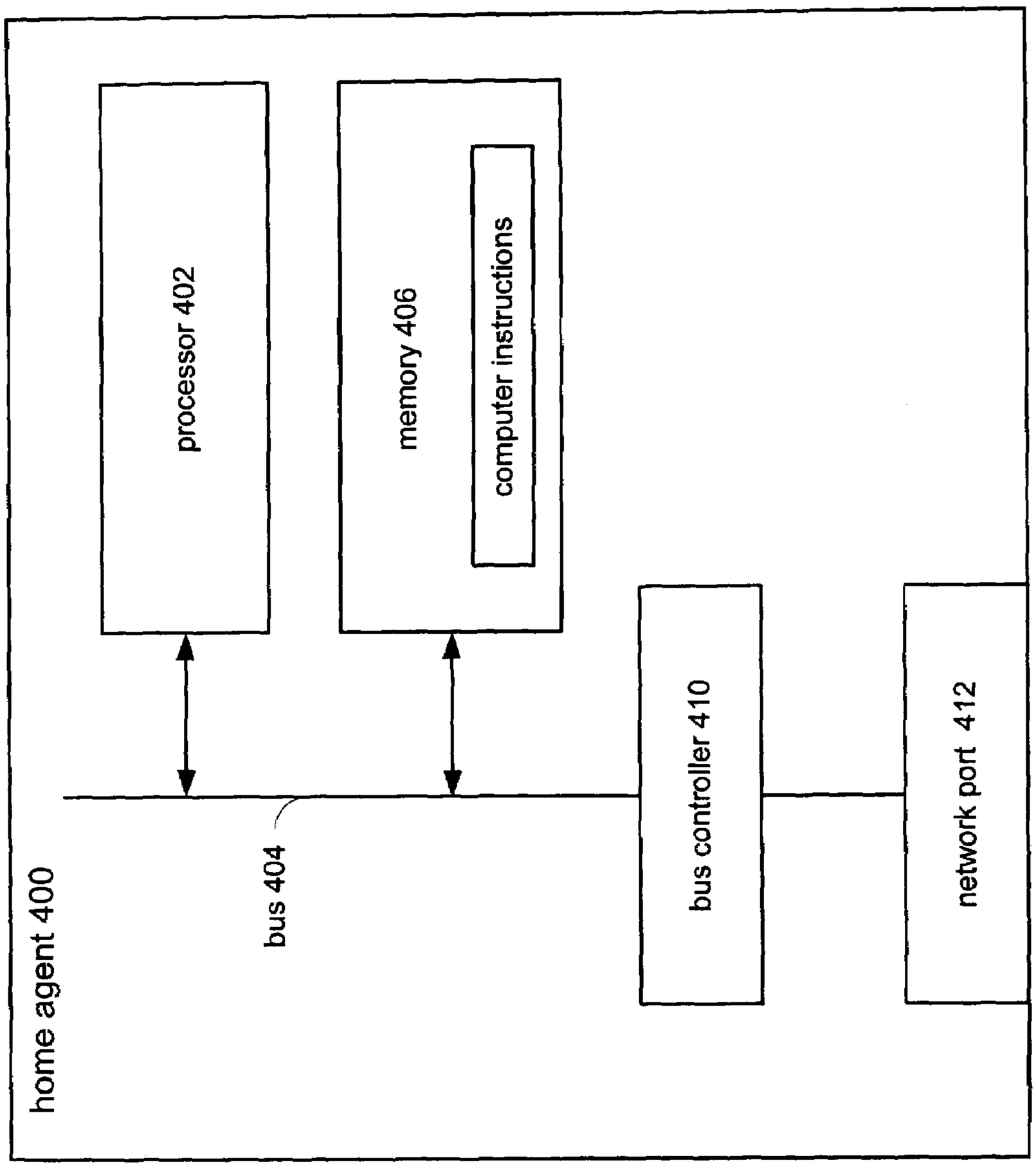

home agent 400
bus 404
processor 402
memory 406
computer instructions
bus controller 410
network port 412

FIG. 4

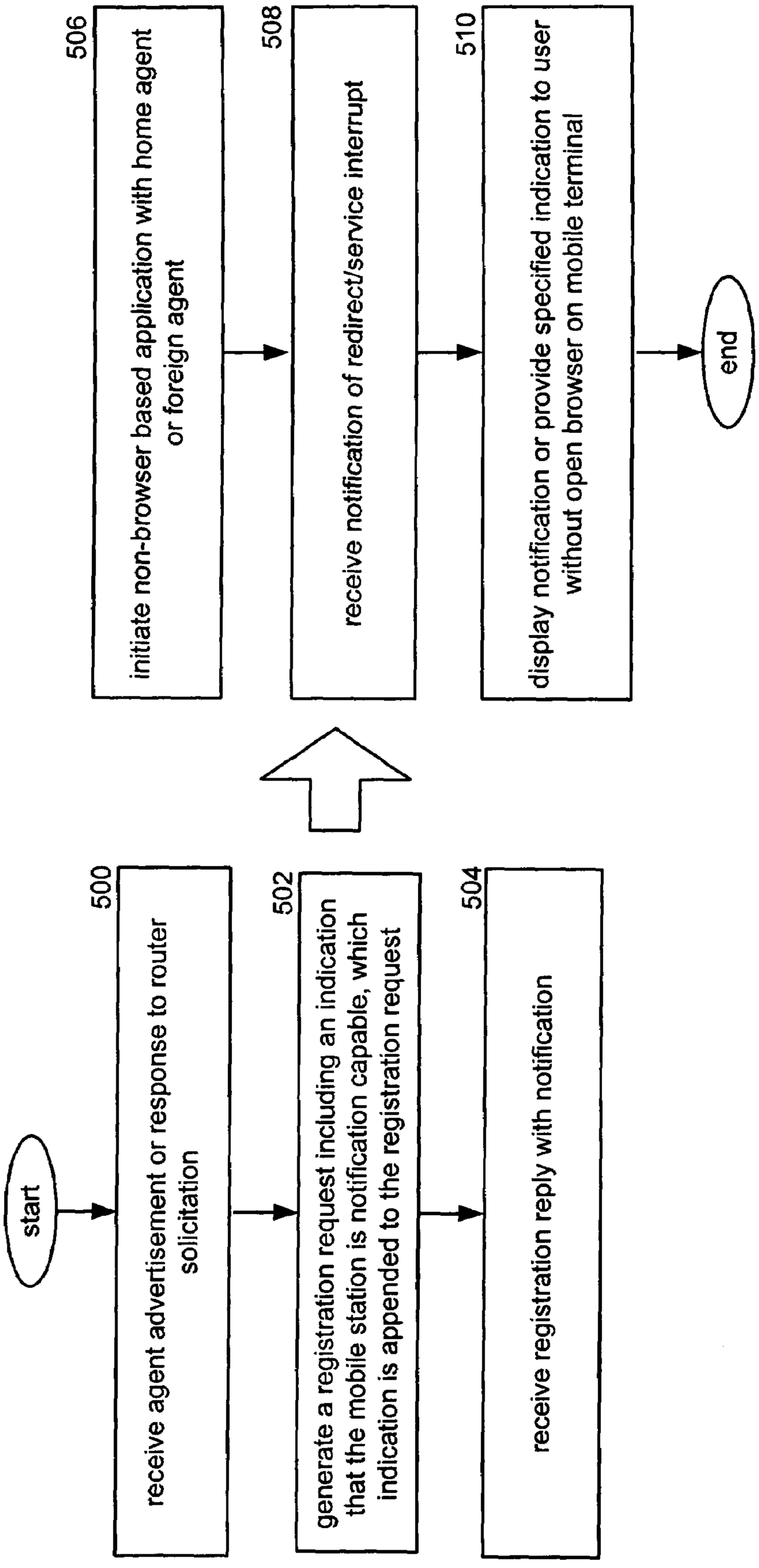

start
receive agent advertisement or response to solicitation
500
generate a registration request including an indication that the mobile station is notification capable, which indication is appended to the registration request
502
receive registration reply with notification
504
initiate non-browser based application with home agent or foreign agent
506
receive notification of redirect/service interrupt
508
display notification or provide specified indication to user without open browser on mobile terminal
510
end

FIG. 5

MOBILE IP NOTIFICATION

BACKGROUND

1. Technical Field

The present invention relates to mobile communication devices and, more particularly, the present invention relates to mobile terminals communicating in one of a mobile IP or a simple IP network.

2. Related Art

The Internet, as we know it today, began as a joint project between the Department of Defense's (DoD's) Advanced Research Project Agency (ARPA) and the United Kingdom's National Physics Lab (NPL) during the height of the Cold War. When planning started in 1967, the project was conceived to distribute communications and data through a dispersed network of highly interconnected network nodes with high redundancy. A decision was made, based on research at the NPL, to move data through the network using a technique called "message switching", or packet switching as it is called today. In order to exchange data, each node was assigned a unique address in relation to the addresses assigned to all other nodes. The address scheme devised was a 32-bit number comprising a network part and a host (network node) part. By 1971, 15 nodes, mostly at universities, were connected to the ARPA network (ARPANET). They were linked for time sharing to support a variety of remote terminals and allowed data transfers between distant computers.

The early 1970s produced a number of products that would effect the development of the ARPANET. The Palo Alto Research Center (PARC), funded by Xerox Corporation, developed a graphical user interface (GUI), a computer pointing device called a mouse, and most importantly, an Ethernet protocol, for inter-connecting computers that allowed users to send and receive electronic mail and share files.

At the same time that ARPANET was being develop for institutional use, the first personal computer was introduced by Altair in 1975. Sold as a kit, it was an instant success with computer enthusiast but its sales were limited due to the technical skill required to assemble the kit. It did, however, confirm that a market existed for a personal computer. Thus, in 1981, International Business Machines (IBM) introduced the Personal Computer (PC) which became the defacto industry standard. The IBM PC was an open architecture machine, meaning IBM published all technical details of the PC. This fact allowed low cost providers to produce PC "clones" so consumers were able to purchase personal computers at affordable prices. Low cost dial-up modems allowed PC users to download files from bulletin boards.

By the late 1980s, the ARPANET was almost 20 years old. The DoD split the ARPANET into two distinct parts for specific uses. One part was reserved for military sites (known as MILNET), while the second part of the ARPANET was for civilian use. Management of the ARPANET was turned over to the National Science Foundation (NSF) with NSF regional networks forming the backbone of the re-named Internet. Commercial Internet Service Providers (ISPs) began offering Internet Access Points (APs) through which large numbers of PC users began accessing the Internet. These PCs were desktop machines whose location was not likely to change, thus creating a home network for ISPs.

As technology evolved, smaller, more powerful laptop PCs became available. Their size released them from the desktop and the office. Sales, marketing, and technical personnel could take the laptop PCs on the road while maintaining contact with the office through remote applications such as e-mail and file transfers. These laptop PCs created mobile

users that wanted to access the Internet while moving between networks, thereby causing a transition from a centralized system to a distributed system. Moreover, advances in wireless technology made wireless networking possible. Using a mobile IP protocol, laptop PCs, personal digital assistants (PDAs) and mobile phones equipped for web browsing could access the Internet. Using either a static or dynamic mobile IP address assigned by their home networks, these mobile users or mobile terminals accessed the Internet from any available Internet access point.

Along these lines, mobile IP standards have evolved to facilitate mobility for wireline and wireless coupled user terminals (hereinafter, "mobile terminals"). When a mobile terminal changes its access point from its home network to a visited (foreign) network, it does not change its mobile IP address. Home agents (HA) are special servers responsible for routing data packets to absent mobile terminals. The HA is informed of the absent mobile terminal's location when the mobile terminal registers with the foreign network. The server on the foreign network, the foreign agent (FA), provides its IP address (care-of address) to the HA during mobile terminal registration. After registration, the FA is responsible for routing data packets between the mobile terminal and home network via the HA.

Within the world of wireless communications, differing billing rates and services are often offered according to time of day, quality of service and guaranteed throughput rates. For example, some services are offered in which a certain type of continuous-bit-rate data, so called streaming data, is provided at a specified price. For example, there are subscription based music and video services that are readily available. There are also subscription based stock market services and other services in which data is provided for a fee. While such application specific services often are offered at a flat rate, data rate guarantees result in differing transmission rates. Moreover, as the different technologies evolve, the access technology that is utilized to gain access to various application servers is also rate dependent. For example, if an access technology includes a cellular network to provide access to the Internet, then the access technology on its own provides a use based rate. Moreover, if certain quality of service or throughput rates are expected or guaranteed for the access, then different rates may apply according to the throughput rate which is requested or used. On the other hand, if a wireless local area network is used to provide access to a data packet network, such as the Internet, then there may be no service fees associated therewith aside from, perhaps, monthly fees.

One problem that exists in mobile IP and simple IP networks is that there are situations in which a mobile terminal accessing a particular address for a specified non-browser related service cannot be accommodated as requested and, if the desired service cannot be provided, there is no mechanism for providing an indication of such to the user of the mobile terminal. For example, when a mobile terminal establishes a communication link in conjunction with the home agent, the requested application, for example e-mail, may require connecting the mobile terminal to a specified website other than a requested e-mail host web address to enable the mobile terminal to access its e-mail. Moreover, for any one of a plurality of reasons, there may be an event that triggers rerouting the mobile terminal to a different address or application. For example, if the mobile terminal's subscription services are not current, then the mobile terminal may be routed to another website or even have its request for the particular application be denied. As another example, a service being provided at a first level of quality (potentially having an associated cost therefor) may, for any one of a plurality of

reasons, require a service being provided at a second level of quality (having a different associated cost therefor). In either situation, the application may be of a type that does not require an open browser window, yet there is no mechanism for providing feedback to the user of the mobile terminal that the application service is being denied or, alternatively, that the mobile terminal is being redirected to a different web address or that a different service is to be provided.

Accordingly, there is a need in a wireless data network for a method and apparatus to provide an indication of whether a service request is being denied or whether a mobile terminal is being routed to a different web address even though such different web address was not requested in those instances in which an application is being accessed without an open browser window and whether a service level or quality is being changed.

SUMMARY OF THE INVENTION

A method and apparatus in accordance with the present invention includes a home agent and a mobile terminal that communicate to facilitate the home agent (or foreign agent) becoming aware of whether the mobile terminal is notification capable wherein, if the mobile terminal is notification capable, the home agent (foreign agent) provides notifications based upon specified events and conditions. The mobile terminal then provides an indication of the notification to the user even though a browser window is not open for displaying user messages. The notification may be in the form of a tone, beep, text message, specified code, etc. The mobile IP registration process according to a mobile IP (or simple IP) protocol is modified to add parameter extensions that allow the mobile terminal to provide this indication that it is notification capable. The home agent is notification capable as well and is capable of providing specified notifications to the mobile terminal upon the occurrence of a specified event without using known browser technology and associated graphical user interfaces for producing graphics and information to a user.

For example, either upon registration or during a mobile IP data session, a particular notification may require being provided to the user of the mobile terminal. In one embodiment of the invention, a mobile IP notification extension (NE) includes a notification code and optional accompanying text describing an aspect of the notification. Generally, however, the home agent only provides such notification if the mobile terminal provided an indication that it is notification capable during a data session or call setup process step. For example, in one embodiment, the mobile terminal provides an indication that it is notification capable as a part of transmitting a registration request. The home agent may produce said notification either in response to call setup processing (e.g., the registration request) or in response during a specified event during a call or data session in the wireless network. With respect to the cellular network, the access technology type may be any one of cdma2000, 1xEV-DO, 1xEVDD, Universal Mobile Telecommunications System (UMTS), General Packet Radio Service (GPRS), or other such standards based specification.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention can be obtained when the following detailed description of the preferred embodiment is considered with the following drawings, in which:

FIG. **1** is a functional block diagram of a communication network formed according to one embodiment of the present invention;

FIG. **2** is a signal sequence diagram that illustrates mobile terminal registration according to one embodiment of the present invention;

FIG. **3** is a functional block diagram that illustrates registration and call setup according to one embodiment of the present invention;

FIG. **4** is a functional block diagram of a home agent according to one embodiment of the present invention; and

FIG. **5** is a flowchart illustrating one method according to the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. **1** is a functional block diagram of a communication network formed according to one embodiment of the present invention. As may be seen, a communication network **100** includes many networks that are coupled to operatively communicate with each other to enable a user in one type of network to communicate with a user in a different type of network. For example, the communication network **100** creates an ability for a wire line user terminal coupled to a private network to communicate with a mobile terminal through a wireless communication link. Such transparent operation with respect to the user is improving access to information and the ability for individuals to communicate to a level that is unprecedented. Existing wireless networks have, heretofore, been adapted primarily for carrying voice calls. Accordingly, when used in conjunction with a computer terminal, the wireless voice networks were able to transmit or receive data at rates that today are viewed as unacceptably slow although they were appreciated at the outset.

Along these lines, a mobile station **102** is located within a geographic area served by a Base Transceiver Station (BTS) **104** that is coupled to an Access Network Controller (ANC)/Base Station Controller (BSC) **106**. More specifically, mobile station **102** communicates with BTS **104** by way of an IS-95 CDMA wireless communication network link shown generally at **108**. Similarly, a mobile terminal **110** that is capable of supporting both voice and data calls communicates with BTS **104** over a wireless communication link shown generally at **112** and establishes either voice calls or data calls under cdma2000 1xRTT protocols. In the example herein, mobile terminal **110** is engaged in a voice call, as defined by a service option generated by a mobile terminal during call setup, and thus wireless communication link **112** is transmitting merely voice signals and associated control signaling.

Similarly, a mobile terminal **114** is engaged in a data call (data session) according to 1xRTT protocols over a wireless communication link shown generally at **116**. Finally, an access terminal **118** is engaged in a data session over a wireless communication link, shown generally at **120**, according to 1xEV-DO protocols in a so called "simple-IP" or "mobile-IP" network, as those terms are understood by one of average skill in the art. In general, simple-IP and mobile-IP networks do not include control-signaling protocols that are as extensive as some existing systems including 1xRTT.

Continuing to examine FIG. **1**, BTS **104** is generally coupled to communicate with ANC/BSC **106** (or with packet control function cards there within). As is understood by one of average skill in the art, access network controllers and base station controllers have similar functionality. Moreover, Packet Control Function (PCF) cards can be installed either within a BSC or within an ANC according to whether the PCF is to communicate with a 1xRTT device or a 1xEV-DO

device, respectively. It is to be understood that the BSC and ANC elements may readily be formed as stand alone units, but are shown herein as combined systems for illustration.

Within ANC/BSC **106**, a plurality of different wireless network cards is included to facilitate communications with mobile stations and mobile terminals of differing protocols and types. For example, in the described embodiment, ANC/BSC **106** includes circuitry to communicate with mobile station **102** over IS-95 CDMA wireless communication network link as shown generally at **108**. ANC/BSC **106** further includes a PCF **122** for communicating with mobile terminals **110** and **114** utilizing 1xRTT protocols. As may be seen, PCF **122**, which is for communicating with 1xRTT protocol devices, is coupled to a Mobile Switching Center (MSC) **124**. A PCF **126**, however, is for communicating with 1xEV-DO devices and thus it is coupled directly to a Packet Data Serving Node (PDSN) **128**. Thus, access terminal **118** that communicates over wireless communication link **120** according to 1xEV-DO communication protocols, communicates with BTS **154** and with PCF **126** formed within ANC/BSC **106**. It is understood, of course, that PCF **126** may readily be formed as a distinct device rather than within a rack of ANC/BSC **106**. Moreover, PCF **126** may communicate with access terminal **118** through distinct radio equipment and, thus, through a BTS other than BTS **154** as shown herein.

MSC **124** further is coupled to a Public Switched Telephone Network (PSTN) **130**. Accordingly, calls routed through MSC **124** are directed either to other MSCs (not shown herein) or to external networks by way of PSTN **130**. The reference to PSTN herein includes SS7 and other similar "intelligent networks". 1xRTT data and 1xEV-DO calls, which are processed by PCF **126**, however, are forwarded through PDSN **128**, which, upon authentication by an Authentication, Authorization and Accounting (AAA) server **132**, is connected to a data packet network, which, in this example, comprises Internet **134**. As may further be seen, Internet **134** is coupled to a private network **136** by way of a gateway device **138**. Private network **136** further is coupled through traditional wire line networks to a user terminal **140**. Private network **136** is further coupled to mobile terminals **142** and **144** through a wireless network. In one embodiment, private network **136** comprises a wireless local area network with at least one access point which provides access for mobile terminals **142** and **144** and comprises wireless LAN terminals. Private network **136** can include home agents and foreign agents for mobile terminals **136** and **144**. Alternatively, a PDSN, such as PDSN **128** or a Gateway GPRS Support Node (GGSN), such as GGSN **152** of a General Packet Radio Service (GPRS) network, may serve as a foreign agent or home agent.

Internet **134** further is coupled to application server **146** by way of gateway device **150**. A Global System for Mobile Communications (GSM) mobile terminal **149** is coupled to Internet **134** by way of GPRS network **148**. GPRS network **148** represents the GPRS architecture, such as base station controller, mobile switching center, and serving support nodes. GGSN **152** is the interface between Internet **134** and GPRS network **148**.

Continuing to refer to FIG. **1**, ANC/BSC **106** further is coupled to BTS **154**, which is in communication with an access terminal **156** by way of a 1xEV-DO communication link **158**. As may be seen, access terminal **156** is served by PCF **126**, as is access terminal **118**. Additionally, a BTS **160** is coupled to a PCF **162** that, in turn, is coupled to communicate with a PDSN **164**. Thus, a mobile station, such as mobile station **102**, may communicate with BTS **160**, BTS **104**, or both. PCF **162**, as may be seen, is a standalone system rather than being integrated as a card in an ANC or a BSC.

As will be described in greater detail below, any one of the mobile terminals or access terminals may communicate with a device by way of Internet **134** through a home agent (HA) or a foreign agent (FA) depending on the Internet access point. In the described embodiment, the mobile terminal that is not within the service area of the HA will register with the HA through the FA. The FA accesses network profile information and routes data packets according to the data packet destination address and/or the application type. Data packets not destined for the home network will be routed through Internet access points thereby reducing the amount of data packets transported by the home network infrastructure according to profile information, policy information, and/or according to a destination address. Accordingly, network resources are not unnecessarily used and efficiency is improved.

For each mobile terminal or access terminal, such as mobile terminals **118** and **156**, that accesses Internet **134** or private network **136** by way of a home agent or foreign agent, the home agent, by virtue of the use of simple IP or mobile IP protocols, is not ordinarily able to provide required notifications during a particular call or data session that does not include an open browser window. Accordingly, the mobile terminals of the present invention include logic for generating call setup signals, e.g., a registration request that includes parameter extensions to enable the mobile terminal to provide an indication to the home agent that the mobile terminal is notification capable. Accordingly, the home agent can provide specified notifications to the mobile terminal upon the occurrence of specified events. For example, if mobile terminal is being redirected to a new address (presumably one that was not requested), then the HA provides an indication that the mobile terminal that it is being redirected to a different address, as well as a message displaying the address of the location to which the mobile terminal is being redirected (the new address). As another example, a change in service quality may be indicated in a notification message that further includes text describing the new service quality and/or cost therefor. The notifications originated by the HA or an FA are generated for delivery to the mobile terminal.

FIG. **2** is a signal sequence diagram that illustrates mobile terminal registration according to one embodiment of the present invention. Generally, the invention includes the mobile terminal advising a home agent, either directly or by way of a foreign agent, of its presence in a registration request to gain access to a network. The home agent then may perform billing or other control related functions that are responsive and correspond to the mobile terminal. More generally, as mobile terminal (MT) **200** moves from its home network, a home agent (HA) **204** must update the location of the mobile terminal in a home list. HA **204** is a specially designated server that is responsible for receiving and forwarding data packets to the mobile terminal. Any HA serving a visiting mobile terminal is considered a foreign agent (FA).

As the mobile terminal moves into a foreign (visited) network, it must register its location with its HA. The mobile terminal may use an FA, such as FA **208**, to assist with this registration if such an FA is present in the network. In order to obtain profile and other information for a mobile terminal, an HA, such as FA **208**, will communicate with a local Authentication, Authorization, and Accounting (AAA) server **212** or with a home AAA server **214**. To establish a communication link with MT **200**, FA **208** will periodically send out an agent advertisement **216** containing a care-of address. The agent advertisement is a special IP packet periodically broadcast by home agents and foreign agents to notify mobile terminals of

their location and that they are available for connectivity. The care-of address is the IP address of FA **208**. In the event MT **200** does not receive agent advertisement **216**, it will send router solicitation **220**. Router solicitation **220** is a message sent by the mobile terminal to discover a foreign agent in order to obtain the care-of address. In the described example, FA **208** receives router solicitation **200**. Upon the receipt of either agent advertisement **216** or response to router solicitation **220**, MT **200** registers with the HA. MT **200** will send, in the described embodiment of the invention, registration request **222** containing an indication that MT **200** is notification capable.

FA **208** will, upon receiving registration request **222**, send access request **226** containing the mobile terminal identification (including device type and access technology in one embodiment) to local AAA server **212**. Access request **226** is, generally, a signal for identifying the mobile terminal to establish accounting for services used. Local AAA server **212** is a specialized server that verifies MT **200** authentication. Local AAA server **212** then forwards access request **226** to home AAA server **214** which responds with access accept **230** for an authenticated mobile terminal to indicate the mobile terminal is authorized to access the Internet. Once authentication has been received, FA **208** sends registration request **234**, containing the care-of address of FA **208**, to HA **204** which stores the care-of address of FA **208** in the MT **200** profile. When HA **204** receives a data packet addressed to MT **200**, HA **204** will encapsulate the data packet with the care-of address and forward the encapsulated data packet to PA **208**.

HA **204** returns a home address **238** with registration response **242**. In general, registration response **242** is a reply from the HA to the mobile terminal used to complete the registration process. If MT **200** is assigned a static IP address, HA **204** returns the static IP address as the home address. For a dynamic addressing, HA **204** will assign an IP address and return the IP address as the home address with registration response **242**. FA **208** sends accounting start **246** then sends registration response **250** to MT **200**. MT **200** is now registered and can access the home network or any other data packet network.

If, during the above described process, the HA is required (for any reason) to redirect MT **200** to an address other than that which is requested (or required for a requested service) or if the HA is required to provide any other notification information to the mobile terminal, then the invention includes providing notification to MT **200** by way of FA **208** of the same. In this described embodiment, the notification is provided in response to registration request **234** in registration response **242** as an MIP RRP (mobile IP registration response) with a defined notification and a text field that defines specifics of the notification. For example, the defined notification may be "Redirect" and the accompanying text may be "User has been redirected to http//www.xyz.com". Alternatively, the defined notification may be "Request Denied" and the accompanying text may be "Service Temporarily Unavailable".

If appropriate, the invention further includes initializing a corresponding accounting process to bill for the specified service in accounting start **246** that is produced by FA **208** to Home AAA server **214** and producing a registration response **250** to MT **200** to advise it either that the requested service is being provided or is being denied as well as any accompanying notification messages (if any). If requested service is provided and, during the call or data session, MT **200** is to be redirected or if the call or data session is interrupted, a redirect/service interrupt mobile IP notification message **252** is produced by HA **204** to FA **208** for delivery to MT **200** with the defined notification message and any accompanying text. Accordingly, FA **208** produces notification message **254** to MT **200** with the notification and accompanying text, if any.

Finally, the signal sequence diagram of FIG. **2** further illustrates a method according to one embodiment of the present invention for clearing a previously submitted notification. Specifically, one of a home agent or a foreign agent may generate a notification message **256** with an empty text field to clear a previously submitted notification with text field. A notification with an empty text field may also be sent as a part of registration response **242**. Generally, this embodiment contemplates a mobile terminal that displays whatever is received in a text field of a notification message. Accordingly, an empty text message is produced to MT **200** in either signals **250** or **258** to prompt the mobile terminal to "display" the empty text field thereby effectively clearing the previous display.

FIG. **3** is a functional block diagram that illustrates registration and call setup according to one embodiment of the present invention. More specifically, a mobile terminal **300** registers with foreign agent **304** and home agent **308** by way of mobile IP tunnel **328**. During or subsequent to the registration process, foreign agent **304** receives mobile terminal information from home authentication, authorization and accounting (AAA) server **312** via local AAA server **316**. When mobile terminal **300** attempts to access a data packet network, such as home network **324**, foreign agent **304** will access local AAA server **316** and route the data packets accordingly. As may be seen, mobile terminal **300** produces its mobile terminal IP address, home network IP address, and optionally device type and access technology, in one or more communications with foreign agent **304**. In the described embodiment, said information is transmitted in a registration request signal.

The routing is based upon one of a network policy and a subscriber policy in relation to, among other factors, device type and access technology in one embodiment of the invention. The network policy can specify routing data packets according to an address specified by the mobile terminal or based on an application type associated with the data packet. The application type includes home network **324** applications such as e-mail, file sharing, and establishing a session initiation protocol (SIP) for video conferencing and telephony over IP-based networks. If the application type is of a type specified for home network **324** and device type and access technology, foreign agent **304** will encapsulate the data packet creating mobile IP tunnel **328** for routing the data packet to home agent **308** for forwarding to home network **324**. The data packet will be routed to the Internet if the application type is not of a type specified by the network policy. The network policy may also specify routing based on a destination address such as the address of a network node in home network **324**. According to routing policy rules, foreign agent **304** either routes data packets to a destination address or to home agent **308**. If, for some reason, foreign agent **304** cannot route data packets to a requested or specified web address location, then foreign agent **304** provides notification of the same to mobile terminal **300**. Moreover, if the packets are routed to home agent **308** prior to being connected to a specified web address location and home agent **308** determines that the mobile terminal cannot be "connected" to the web address location, then home agent **308** generates a notification message for delivery to mobile terminal **300** by way of mobile IP tunnel **328** and foreign agent **304**.

Home AAA server **312** may also specify subscriber profile information. Information stored in home AAA server **312** will be accessed by foreign agent **304** during registration via local

AAA server **316**. Foreign agent **304** will use the information received via local AAA server **316** when mobile terminal **300** accesses a data packet network. Foreign agent **304** will apply the subscriber profile for mobile terminal **300** to route the data packet according to at least one of a destination address, specified application type, device type and access technology. In any of the above embodiments, the invention includes the mobile terminal transmitting an indication that it is notification able and also includes the home agents and the foreign agents transmitting notification.

FIG. **4** is a functional block diagram of a home agent according to one embodiment of the present invention. Home agent **400** includes a processor **402** that is coupled to communicate over a bus **404**. A memory **406** further is coupled to bus **404** and is for storing computer instructions that define the operational logic of home agent **400** including notification logic as described herein. Memory **406** specifically includes computer instructions to cause home agent **400** to add notification information to registration reply messages transmitted to a mobile terminal. Bus **404** further is coupled to a bus controller **410**, which controls the communications and timing of communications thereon. Bus controller **410** is further coupled to a network port **412** that enables home agent **400** to communicate with a mobile IP network. Network port **412** can be one of any type of transceiver front end, including those used in wireless as well as wireline technologies.

In operation, processor **402** communicates with memory **406** by way of bus **404** to retrieve computer instructions stored therein and to execute the computer instructions to operate according to the logic defined within the computer instructions of memory **406**. Memory **406** specifically includes computer instructions that define the logic for performing registration of a mobile terminal. Additionally, computer instructions stored in memory **406** define logic for determining an access technology by which the home agent is to send the registration replies including specified notifications and, more generally, communicate with a mobile terminal by way of a mobile IP tunnel and a foreign agent. Finally, the computer instructions include logic for generating any one of a plurality of notifications that are sent either as a part of a registration reply or during a call or data session to provide notification of a specified event. The logic, however, is directly related to mobile IP and simple IP technology devices that do not have means for providing notifications outside of a browser window (without using an open browser window).

FIG. **5** is a flowchart illustrating one method according to the present invention. A mobile terminal initially receives an agent advertisement or a response to a router solicitation that the mobile terminal transmitted in order to locate an access point (step **500**). In a cellular network, the mobile terminal receives a beacon or paging signal that indicates the presence of a base station. The mobile terminal then generates a registration request including an indication that it is notification capable, which indication is appended to the registration request in one embodiment of the invention (step **502**). For example, if the mobile terminal receives an agent advertisement or response to a router solicitation, as well as a beacon or paging signal from a base station, the mobile terminal has a plurality of means for accessing a network. Thus, the mobile terminal may choose the cellular network to satisfy throughput requirements for a specified application, or may choose the lowest cost access technology which, more than likely, will be the WLAN since WLANs are typically operated by private organizations or individuals. Regardless of the access technology, however, the registration request signal includes an indication that the mobile terminal is notification capable as defined herein this application.

The mobile terminal subsequently receives a registration reply with notification if a specified event or condition warrants a notification being sent to a registering mobile terminal (step **504**). The notification can be of any type described herein and generally includes a specified notification with associated text messages if so required. One notification specifically included is that the mobile terminal is to be redirected to an alternate web address location. If service is not denied or if the mobile terminal is not redirected to an alternate web address location, the mobile terminal initiates a non-browser based application with the home agent or foreign agent (step **506**). In the described embodiment of the invention, a registration request is generated and transmitted to one of a base station or access point. Thereafter, once a particular data session or call type is initiated, the invention includes receiving notification of redirect/service interrupt in a notification message with corresponding text describing the redirect/service interrupt (step **508**). Thereafter, the mobile terminal displays the notification text or provides a specified indication to the user without an open browser on the mobile terminal (step **510**). If, during the data session, the mobile terminal data session is interrupted or if, for some reason such as a server or line failure, the mobile terminal session is to be terminated or suspended or redirected, notification of the same is provided so that the user may understand the interruption or delay in service. Finally, a home agent or foreign agent may produce a notification message to a mobile terminal as described herein with an empty text field to clear or erase a previously submitted text message as a part of a notification.

The invention disclosed herein is susceptible to various modifications and alternative forms. Specific embodiments therefore have been shown by way of example in the drawings and detailed description. It should be understood, however, that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the invention is to cover all modifications, equivalents and alternatives falling within the spirit and scope of the present invention as defined by the claims.

What is claimed:

1. A mobile IP network; comprising:

a mobile terminal that provides an indication, within a registration request signal for a non-browser based application, of having a notification capability;

a home agent (HA) that receives and processes a registration request with the indication of notification capability wherein the HA provides one of a redirect notification or a service notification if a specified service request cannot be provided; and

wherein the mobile terminal stores the redirect notification or service notification in a specified manner without using a browser window.

2. A home agent (HA) for serving a mobile terminal in a mobile IP network, comprising:

a processor for executing computer instructions that define operational logic of the HA;

a bus coupled to the processor for transmitting computer instructions and control signals to and from the processor within the HA;

a bus controller for controlling communications and timing of communications thereon;

a network port for coupling the HA to a wireless communication network to enable the HA to communicate with the mobile terminal;

memory coupled to the bus, the memory including the computer instructions that define operational logic for routing data packets between the mobile terminal, the defined HA and a web server;

the memory further including computer instructions that define logic for communicating with the mobile terminal;

wherein the HA receives a registration request from the mobile terminal including an indication that the mobile terminal is capable of receiving and processing a specified indication which specified indication includes one of a redirect notification or a service notification if a specified service request cannot be provided; and

wherein the HA provides one of the redirect notification or the service notification if the specified service request cannot be provided.

3. The HA of claim **2** wherein the redirect notification is provided to the mobile terminal even though a browser page is not activated on the mobile terminal.

4. The HA of claim **3** wherein the redirect notification is provided to the mobile terminal along with an indication of a web site address to which the mobile terminal is being redirected.

5. The HA of claim **4** wherein the mobile terminal is redirected in response to the registration request.

6. The HA of claim **4** wherein the mobile terminal is redirected while in a mobile IP data session.

7. The HA of claim **2** wherein the HA sends an empty notification message to the mobile terminal to prompt the mobile terminal to clear out a previously received notification message.

8. A mobile terminal for use in a mobile IP network, comprising:

a processor for executing computer instructions that define operational logic of a home agent (HA);

a bus coupled to the processor for transmitting computer instructions and control signals to and from the processor within the HA;

a bus controller for controlling communications and timing of communications thereon;

transceiver circuitry for enabling the mobile terminal to communicate with the HA by way of a communication network;

memory coupled to the bus, the memory including the computer instructions that define operational logic for establishing a communication link with the HA; and

wherein the mobile terminal produces a registration request including an indication that the mobile terminal is capable of receiving and processing a specified indication which specified indication includes one of a redirect notification or a service notification if a specified service request cannot be provided.

9. The mobile terminal of claim **8** wherein the mobile terminal receives and processes the redirect notification even though a browser page is not activated on the mobile terminal.

10. The mobile terminal of claim **9** wherein the mobile terminal receives the redirect notification along with an indication of a web site address to which the mobile terminal is being redirected and wherein the mobile terminal displays at least a portion of the web address provided with the redirect notification.

11. The mobile terminal of claim **10** wherein the mobile terminal receives and processes the redirect notification in response to the registration request.

12. The mobile terminal of claim **10** wherein the mobile terminal receives and processes the redirect notification in a mobile IP data session.

13. The mobile terminal of claim **8** wherein the mobile terminal receives and processes the redirect notification with an empty notification message and further wherein the mobile terminal clears a previously received notification message.

14. A method by one of a mobile terminal and a home agent in a mobile IP network, comprising:

the mobile terminal transmitting a registration request, the registration request indicating that the mobile terminal is notification capable for receiving redirect notification even though a browser window is not open;

the mobile terminal receiving a notification, without having an open browser window, indicating one of a service notification or a redirect notification reflecting that the mobile terminal is being redirected to a web site not requested by the mobile terminal; and

the mobile terminal providing an indication of the notification to a user of the mobile terminal.

15. The method of claim **14** wherein the mobile terminal receives the notification in response to a registration request message generated by the mobile terminal.

16. The method of claim **14** wherein the mobile terminal receives the notification in a mobile IP data session.

17. The method of claim **14** wherein the home agent receives an indication that the mobile terminal is notification capable.

18. The method of claim **17** wherein the home agent determines that a notification is to be provided to the mobile terminal.

19. The method of claim **18** wherein the home agent provides notification to the mobile terminal in response to the registration request message.

20. The method of claim **18** wherein the home agent provides notification to the mobile terminal during an established mobile IP data session.

* * * * *